A possible solution to the shortage of affordable housing in Nairobi, Kenya

- A field study in Nairobi County

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Abstract

In a bid to curb housing problems in Nairobi, which are so enormous to a point of becoming one of the Government of Kenya's 'Big four agenda' which entails the top government's priorities in terms of development. So, this case is perfectly fitted for the study. This study focuses on the largest city in Kenya (in terms of population), Nairobi. Nairobi is growing in population at a rate of over 4 % which makes it one of the fastest growing cities in the continent. The housing shortage in Kenya is affecting mainly the low-and middle-income earners. In order to solve the housing shortage, mass production of affordable housing is an essential goal. The study investigates if the utilization of the EPS technology could solve the housing menace in Nairobi county. Nonetheless, it is possible to utilize EPS technology as a construction technology in the housing sector in Nairobi, although not entirely. This solution has been tailgated by multiple challenges, which are vastly explored in this report. EPS technology, however, stands out as the most appropriate building solution in such context. The construction technology (EPS) faces multiple challenges in Nairobi county but can however have solutions that could be suppressed, and they are also proposed in the report.

Keywords: Housing shortage, EPS technology, Lean construction, Technophobia & Affordable housing

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List of contents

1 Introduction

1.1 Background

The population of Africa is increasing dramatically. Research done by Hans Rosling showed that in 2100 Africa will be home for 39% of the global population, which is very high. Not only the population is increasing in Africa but also the economic growth is rising. Kenya, officially known as the Republic of Kenya is home for 51.3 million people and the number is still rising (Worldometers, 2018). 22 % of the Kenyan population lives in cities. The urbanization is growing at a rate of 4.2 % every year which is equivalent to 500 000 new residents moving into the cities every year (Baer D, 2015). The spontaneous settlements (Slum), is expanding due to the shortage of affordable housing, the necessity of opportunities, the high cost of living and the high urbanization rate. In summary, the demand for affordable houses is higher than ever.

To meet the demand for housing units in Kenya, 200 000 new homes must be built yearly (KPDA, 2018). Today only about 50 000 homes are built annually. Due to these factors, housing prices have increased by 100% since 2004. In behalf of the housing deficit, 61% of the urban households live in the slums.

Nairobi is the capital of Kenya and the largest city in Kenya (by population). Nairobi is growing in population at a rate of over 4 % which makes it one of the fastest growing cities in the continent. The city's population growth is estimated to grow up to 5 million by 2025 (Worldreviewpopulation, 2018).

Prefabricated construction technology involves building individual building components either on-site or off-site (in a factory) and assemble the components in place. The technology has many advantages, but the main benefits are; reduced construction time and reduced total construction costs (Wong, R., Hao, J., & Ho, C. M., 2003).

EPS technology is a prefabrication technology which Andrew Saisi, the General Manager of NHC factory, describes as an astonishing construction technology that reduces the construction costs by 30 percent and reduces construction time by 50 percent. This study examines whether EPS technology, in actuality, can be a solution to solve the shortage of affordable housing in Nairobi County.

1.2 The aim of the report

The aim of this report is to find a possible solution to the shortage of affordable housing in Nairobi county. The study will investigate the utilization of the EPS technology in Nairobi and how this method could solve the problem. This report will also examine the underlying issues that limit the utilization of the EPS technology in Nairobi county.

1.3 Problem description

According to the conference presentation made by KPDA (2016), the urban population is increasing at a rate of 4.2% annually. To minimize the 61% of the urban households living in the slums, Kenya must build 200 000 houses annually to meet the demanded housing units. However, only 50 000 new houses are built annually.

This report investigates the EPS technology used in Nairobi to examine if the technology could minimize the housing shortage. The report focuses on the factors that affect the choice of building technology. EPS technology's economic and technical advantages of obtaining affordable housing have been reviewed. The findings will help the researchers to find effective and faster solutions to produce affordable housing.

1.4 Research questions

The report answers the following questions:

- How does the application of EPS technology appear in the Kenyan building sector?
- What are the factors that can affect the affordability of housing?
- Could EPS technology be a solution for mass production of affordable housing?

1.5 The boundary of the report

There are many prefabrication technologies used in the Kenyan construction industry at the present, such as pre-cast concrete panels, but this report focuses on the EPS technology's utilization in the construction industry in Nairobi county. The technical, social factors and economic aspects of the technology will be lightly introduced.

2 Methodology

This chapter will give a comprehensible overview of how the research should proceed to gather all the information needed to answer the research questions. The method chosen for this study is a qualitative research method which provides a complex description of how people experience a research issue. It provides information about the peoples' point of view about an issue. That is, for example, beliefs, opinions, emotions, etc. Qualitative methods are easier to identify intangible factors, such as "*social norms, socio-economic status, status, gender roles, ethnicity and religion",* whose role can affect the research issue (mack, woodsong, Macqueen, Guest and namey, 2005). A mixture of qualitative research with quantitative methods can offer a better understanding of the complex reality in a given situation. The study used questionaries', observation, and interviews to collect all the information needed for the report.

2.1 Research Process and design

This section describes the research tools used to gather information for the study. Questionnaires, interviews, and observation were the most important tools for gathering information.

2.1.1 Questionnaire

The study used a questionnaire with both open-ended and close-ended questions in order to identify the Nairobi citizen opinions about the housing menace in Nairobi county. The main differences between Open-ended and close-ended questions are the respondents' role when answering such questions. Closed-ended questions narrow the respondents' answers, while open-ended question prevents the researcher to have any impacts on the respondents' opinion (Foddy, 1993: 127, as cited in Urša, Katja, Manfreda, Valentina, Vasja, 2003). The open-ended questions provide the possibility of discovering the answers that the respondents may give spontaneously and

thereby avoiding suggesting answers for the respondents, a bias that may happen when close questions are used. The main disadvantages that come with the open-ended questions are the need for wide coding and greater unanswered response. The questionnaire was prepared based on a comprehensive review of the literature on the subject. See ***Attachment 1 - Questionnaire***.

2.1.1.1 Target Population

The study used a reasonable sample size for questionnaire management. The sample size for this study was 60 due to economic and time motives. The sample size was a mixture of participants with different ethnicity, different income level, different age and from different areas in Nairobi county. The sample size division helps the researcher to understand the diverse views of the housing shortage from various groups in qualitative research (Mack et. Al., 2005).

2.1.2 Interviews

To gather more information from relevant actors in the construction industry in Nairobi, the study used face-to-face semi-structured interview technique. According to Edwin (2014), The method involves fixed open-ended questions where the interviewee can adjust the order of the questions based on the interviewer's perception of what seems most appropriate. The semi-structured interview permits the informant to clarify and expand certain answers which will provide more knowledge about the subject. The content of the open questions can be influenced by the respondent, while the interviewer can introduce follow-up questions to expand the knowledge about the subject. In the interviews that were conducted, the respondents greatly influenced the interviews.

Prior to the interviews, preparation was conducted on which questions that could have been most appropriate. Through literature studies, the basic understanding was obtained in order to be able to ask follow-up questions. See ***Attachment 2-interview questions.***

2.1.3 Observation

The research uses participant observation technique to observe the utilization of the EPS technology in construction projects in Nairobi county. Kawulich (2005) defines a participant observational method as an astonishing tool for collecting data about people, processes, and cultures in qualitative research. The method provides the researcher with the opportunity to have the same perspectives as the group the researcher is observing. It also forms a close bond between the participants and the researcher which could make the participant to reveal more information (DeMUNCK and SOBO, 1998, cited in Kawulich, 2005). The method allows the researcher to view or participate in unscheduled events which will improve, for example, the quality of data collection.

The main limitations about using observation as a tool to collect data are, as mentioned by Kawulich (2005), "*gender, sexuality, ethnicity, class and theoretical approach".* These factors can limit the access to different information, therefore the researcher must understand that these factors may affect the observation, analysis, and interpretation (DeWALT and DeWALT 2002, cited in Kawulich, 2005).

2.2 Data collection methodology

2.2.1 Data collection procedure

The data was collected from the questionnaire, face-to-face interview, and participant observation to gather all needed information regarding the subject. The disadvantages of the research tools were critically considered, and solvable actions were taken to minimize the risk of affecting the study's analysis (See *Consideration*). In the questionnaire, the data was collected from residents in Nairobi county. The data collected from interviews were from relevant actors that were knowledgeable about the subject.

2.2.2 Data analysis and presentation techniques

The qualitative data collected from the questionnaire, interviews, and observation were coded to enable quantitative analysis. The collected data were analysed critically before considering them as credible. Data analysis were done using Microsoft Excel. The information from the toolkits has been analysed and summarized in the result both in text, graphs, and tables.

2.3 Considerations

Everyone who participated in this study was informed prior to the study to avoid suspicious speculation among the participants. It was necessary to inform other relevant stakeholders about the purpose of the study while assuring them that the results would be shared with them after the study.

2.4 Literature studies

In the literature study, Information was obtained from Articles, reports, literature and websites. Information obtained from these sources was read objectively before the information was judged reliable.

3 Literature review

This chapter gives an overview of the main parts of the report. The key components of this report include **housing shortage, affordable housing, construction cost, land cost, Lean construction, and prefabrication**. The chapter creates a general understanding of the report research question and purpose.

3.1 The housing shortage in Kenya

Nora Nthule (2003) states that the housing shortage in Kenya mainly affects the low- and middle-income earners. Since there is a shortage of housing, the price of the accessible houses is beyond the low- and middle-income earners purchase power. This group has no other options than to move to the informal settlements, slums. The difficulty of the challenge is that the government has left the house production to individual owners and the private sector which only focus on making a financial profit (Nora Nthule,2003). This increased the market prices for the few available house units which low- and middle-income earners cannot afford.

3.2 Affordable housing

” The need to provide affordable, sustainable and functionally competent housing is fundamental to the living standards and well-being of individuals and families throughout the World” (Howes, 2002, cited in Wong, Hao, & Ho, 2003). The demand for affordable housing is increasing across the world. To meet the demanded housing units to solve the shortage of affordable housing and to meet the tight construction timetable, mass production of houses is a crucial step. Prefabricated building components reduces construction cost and construction time and even minimize the amount of work needed in the process (Wong et al., 2003). Abelson (2009), describes that affordable housing can be considered as those with a medium level household-income as valued by the country, municipality or the local government that is recognized by the

National Housing and Land Commission. In Australia, housing that is affordable include social-rented and midway housing, offered to a competent household whose needs cannot be met by the market (Abelson, 2009).

The definition of affordable housing varies a little differently depending on the institution in question, but they all agree on that it should solve the needs of low to lower-middle income households (Cytonn Research, 2018).

According to Gichunge, (2001), there are various factors that lead to the establishment of low-cost housing. They include lack of enough and favorable cash to finance any housing development. Such as development closely tied to projected returns to be apprehended by the institutions that offer credit facilities as well as lending services. Most of the financiers of the real estate do focus on middle-level income as well as high-income developments, because of high returns. This is despite high demand in the low-income housing segment, but the affordability of the units is beyond the low-income earners purchasing power. The Kenyan Government came up with a new strategy to accomplish the coming 5 years. The strategy involves building 1 million new homes on 7000 acres in Nairobi, Mombasa, Nakuru, Kisumu, and Eldoret (Cytonn Research, 2018). 80% of the houses are planned to be affordable housing. 20% of the houses are planned to be social housing in the slum areas.

3.3 Cost

Reducing the construction cost is one of the essential keys to obtaining affordable housing. There are other factors that prevent private developers from building affordable houses. Since private developers aim to achieve financial profit, they must either reduce overall construction cost or keep the same costs and focus on building for upper-middle-class and upper-class.

This part will focus on enlightening the two major factors that affect the achievement of affordable housing in Kenya from an engineering point of view.

3.3.1 Building material

The NHC (2016) is describing increasing construction costs as one of the major factors that have made housing unaffordable to most low and middle-income earners. The building materials are an essential resource for building and is estimated, according to Marion (2007), over 60% of the total construction cost. If building materials consist of such a large proportion of the total construction cost, to minimize the building material costs as much as possible is an imperative step in order to achieve affordable housing. According to AfDB (African Development Bank), the construction industry in Kenya is affected by the high cost of building material prices. Due to the high cost of building materials, the cost of residential construction has increased which mainly affects low- and middle-income earners (Marion, 2007).

Conventional materials for building are beyond the reach of most of the global population due to their lack of affordability. In addition to this, the increase in the cost of materials for building, escalating environmental concerns due to the far-reaching misuse of natural resources linked with general construction and other housing development programs impulse the need to look for alternate technological options that can be applied in the construction of affordable housing. Substitute methods, materials and practices of construction replacing conservative building and construction can amount to tumbling the depletion of natural resources and save energy (Reddy, B, V, V and Jagadish, K, S 2003).

A research made by Cytonn (2018) claims that the government is likely to employ ABT (*Alternative Building Technology*) such as EPS (expanded polystyrene) technology to reduce the construction time. Reduced construction time allows fast mass production of housing. Limitation of ABT would be a general conviction that the utilization of the technology does not differ from conventional technology. (Cytonn Research, 2018).

3.3.2 Land

Hassanali (2009) argues that housing projects for low-income citizens should be placed in places of low-land cost. This allows reduction of the land cost component of each residential constituent, thus enabling the sale at lower-prices. In looking for places with low costs of lands, developers have had to embark on low-income housing schemes in locations that are peripheral to the centers where there is the gain of benefit from the proximity to cities, but land costs are significantly lower.

A report from the Hass Consult County country that included 10 counties and 75 cities in Kenya illustrated the land prices in Kenyan counties. The report showed that the average land cost within Nairobi county is Kesh189m which is equivalent to USD 1.89m (George Tubei, 2018).

3.4 Lean Construction

Toolanen (2006) defines Lean Construction as, “a collective term for innovative process models for the construction sector”. Lean construction applicate lean production and lean thinking theories that have been utilized effectively in the car industry (Toolanen, 2006 et al., Koskela,2000). The method is applied to design and manage the construction process in order to obtain enhanced project delivery that meets the consumer’s requirements and increased profitability (Ingle & Wagmare, 2005). The foundation of the method is to maximize the value by eliminating waste in the construction process, such as "waste of time, material and effort” (Aziz & Hafez, 2013).

The word “waste” in this context is mainly referred to all nonessential activities in production (Koskela, 2000). Ohno (1988) identified the following seven types of wastes in the construction process:

- **Waste of Motion** – Refers to unnecessary movements (movements that don’t add value).
- **Waste of waiting** – States to inactivity that occurs when the workers, for example, cannot proceed with a task because of delayed delivery of necessary materials.
- **Waste of inventory** – Points out excess inventory, materials that are not instantly required. Excess inventory affects the budget and necessitates storage.
- **Waste of processing** – Refers to adding activities that do not offer value to the client.
- **Waste of material movement** (Transport)– Refers to the transportation of materials or equipment to a construction site before they are required.
- **Waste of overproduction** – Occurs, for example, when a task is finished earlier than scheduled.
- **Waste of correction (Defects)** – This can be anything that is neglected or not performed correctly the first time that requires additional work that spends time and material.

Koskela (2000) argues that waste of “utilization of labour and machines” as the eighth type of waste in the construction process.

Dulaimi (2008) explains that the construction process is based on a set of activities that require to be managed and improved as such. Disregard of flows creates a challenging problem in the Construction sector. Other management methods (Critical Path Method etc.) impairs the value of flow process, design, and perfection (Dulaimi,2008) because of too much focus on alteration

activities. Lean thinking offers the possibility of reducing precariousness in the workflow. Dulaimi (2008) states that early redesigning of the planning system in the process is an imperative step to attain a dependable workflow.

Toolanen (2006) and Howell (1999) discussed the impact of partnering relationships in the construction process. Improving partnership between the actors is a key factor in achieving a more efficient construction process. Including the actors in the design and production phases forms the opportunity to develop, mutually, a reliable working method for a well-organized construction process with better goal accomplishment (Toolanen, 2006). Howell (1999) states, "Lean supports the development of teamwork and a willingness to shift burdens along supply chains". He explains that partnering relationships can only be successful when reliability is presented which can be provided by the application of lean thinking. The problem in the production systems lies under individuals that enhance their performance without considering how their actions influence the construction process on a larger scale.

Forbes & Ahmed (2004) discussed the limitation of implicating the Lean construction method in developing countries. The application of the method is moving deliberately due to limited expertise or monetary capital to adopt the concept in the construction industry. They argued that fear and uncertainty being the two major factors constraining the adoption of innovative technologies in developing countries.

3.5 Prefabrication system

There are many different terms for prefabrication system such as Pre-assembly, prefabrication, Modularization, etc. (Wong, R., Hao, J., & Ho, C. M., 2003). All these terms describe the same production method which is the production of building components. The components are either assembled on-site or in a factory (off-site). Prefabrication is an effective construction technique that improves quality, reduces total construction time, reduce construction cost, improves function, provides productivity and safety (Wong, R., Hao, J., & Ho, C. M., 2003).

The application of the prefabrication system in most of the countries has provided a successful outcome. Motivations of the adoption of the prefabrication system vary from country to country due to reality and circumstances of the present country (M.Amtered El-Abidi and Ghazali, 2015). M.Amtered El-Abidi and Ghazali (2015) explained that the motivations of the adoption of the technology are related to the weather, Labour wage, waste and pollution, and sustainability principles. In Scandinavia, using prefabrication technology allows housing production to proceed efficiently without being affected by the weather. Countries with high labours wage demand reduction of labour cost which can be provided by the utilization of prefabrication technology. Due to low labour cost in developing countries, the need for utilizing prefabrication is not demanded. From a production point of view, prefabrication building has a similar strategy as automobile manufacturing in Japan. The two industries aim to solve supply chain issues, marketing issues and sales and issue related to product development. The prefabrication technology provides mass production of housing because of the reduction of production time.

Just like any other technology, prefabrication technology has both benefits and limitations. The limitation of the technology is mostly related to transportation cost and constraints. The complication in transportation depends on the type of prefab system and the location of the construction site. These are the limitation related to transportation:

Shipping - Size and load restriction constrain prefab technology. The restrictions vary internationally and between states and counties. The degree of limitation varies depending on the type of prefabrication technique.

Cost - Transport distance, permit allocation and quantity of trailers are the features that can affect the transport cost. Transport distance from the factory to the construction site is usually the most important factor in transporting prefabricated housing.

3.5.1 . Expanded Polystyrene (EPS)

EPS consists of small pellets containing a blowing agent such as pentane. This is heated to about 100 ° C by steam, which creates an expansion of the blowing agent a structure with millions of small air-filled cells (Lee, A. J., Kelly, H., Jagoda, R, 2006). To obtain a very strong and rigid froth structure, the pre-expanded pallets is expanded again in a form with steam or heat. The manufacturers' toxicological tests have exposed that smoke from burning EPS does not constitute the same toxic risk as natural materials. Lee (2006) states “EPSs low thermal conductivity, moderate compressive strength, and excellent shock absorption”. This makes the EPS an excellent building material for housing.

The EPS panel system consists of adapted expanded polystyrene that is lined by wire mesh linked with galvanized truss wire. The panels are then covered with concrete after assembling them on-site. The technology offers

astonishing designs, flexibility, effortlessness of installation, the reliability of the application, and astonishing strength (NHC, 2016).

According to Kageni (2014), the EPS technology provides these benefits:

• Reduction of construction time

• Reduction of labour costs

• Reduction of waste

• Permits mass production

3.5.1.1 Types of EPS panels

The EPS panel used in the Kenyan construction industry, according to NCH, are divided into the following types:

Single Panels: The Single panels are used as a bearing structure for buildings up to six floors. In order to create a space between the mesh and the polystyrene sheet, the mesh is provided with transversal wires. After the panel is installed, the mesh is then coated with concrete on both sides (NHC,2016). This type of panels is used for walls, partitions, cladding, floors, and roofing (Arreda homes, 2019).

Double Panels: The type of panels consist of two single panels with internal and external mesh connected by double horizontal connectors (Arreda homes, 2019). The space between the connectors and the panels are then completed with concrete to strengthen the walls. Both sides are then plastered with concrete or “ready-mix material” (NHC, 2016). This type of panels used to build larger buildings.

Floor panels: The floor panel consists of pre-formed polystyrene froth slab with steel beams which is then combined with cast-in-place concrete (Arreda homes, 2019). This type of panel is used to build floors or roof cladding (NHC, 2016).

3.5.1.2 The EPS technology in Kenya

In 2012, The National Housing Corporation (NHC) established a prefabrication factory in Mvoko. Andrew Saisi, the General Manager of NHC factory, mentioned that the technology will reduce the construction costs by 30 percent and reduce construction time by 50 percent. The factory can produce 126,720 expanded polystyrene panels (EPS) Annually. (Construction Kenya, 2014)

According to CK (Construction Kenya), using EPS panels could reduce the cost of a two-bedroom house, before finishing, to about Sh700 000. That is nearly half the cost compared to houses constructed with bricks and stones. The participants in the housing sector see the technology as the only way to counteract the current housing shortage. (Construction Kenya, 2014)

4 Results

4.1 Overview

This chapter presents data analysis and provides an understanding and the interpretation of analysed data for this study on finding a possible solution to the shortage of affordable housing in Nairobi county. This section also gives an outline of the research finding and a discussion of the various data collected from questionnaire, observations and interviews. The study set out to establish the challenges of housing development for the low-income population in Nairobi County. The findings developed the foundation of the analysis and presentation to follow and serve as a basis on which conclusions and recommendations where deduce. Data was presented in various forms, such as tables, graphs, pie charts, pictures, percentages, and description.

This chapter was divided into 3 phases which include, questionnaires, interviews, and observations.

4.2 Questionnaire

4.2.1 Response rate

An analysis of how the questionnaire was distributed and returned is discussed in this section. Of the 60 questionnaires distributed to the respondents, 50 returned, which consisted of 83.3%, while the other 10 were not returned by the respondents, which consisted of 16.7% as seen in table. Based on the distributed questionnaires, the response rate was not an obstacle that could affect the study's results. See **Table 1**

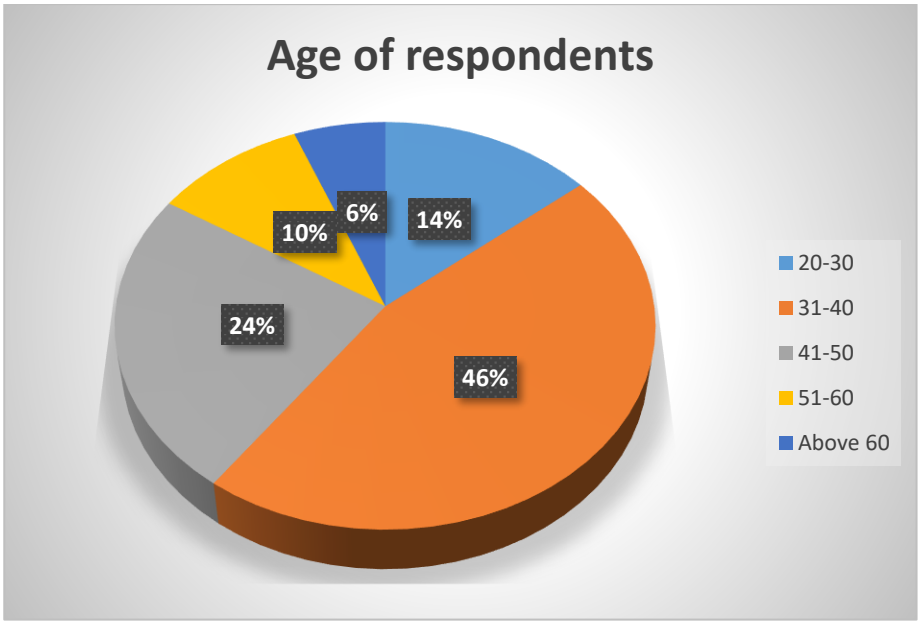
Table 1: Response rate

Category	Number of Respondents	Percentage
Questionnaire returned	50	83,3%
Questionnaire not returned	10	16,7%

4.2.2 Demographic Characteristics of Respondents

4.2.2.1 Age of respondents

Figure 1 Age of the respondents



This study focused on the residents and other stakeholders whose age was over 18 years. Figure 1 shows that the number of participants who were between 20 and 30 years formed 14% of the total number of respondents, the ages between 31 and 40 years formed 46%, the aged between 41 and 50 years formed 24%, those who were between 51 and 60 years was 10%, while the respondents who were over 61 years formed 6% of the total respondents. Those who were 31 above were respondents with family, which was relevant

to the study as their view of the affordability of housing in Nairobi county differs greatly compared to single respondents.

4.2.2.2 The respondent's income level

Table 2 illustrates the respondents' income level. The question helps the researcher to obtain the different views, from the different income groups, about the affordability of housing in Nairobi county. In the questionnaire, the respondents were asked to choose the income group to which they belong by using Treasury Department, ministry of finance category from 2010.

Earning sector	New Classification (Kshs)	Old Classification (Kshs)
Lower income group	0-23,671	0-10,000
Middle income group	23,672-111,999	10,001-40,000
Upper income group	More than 120,000	More than 40,000

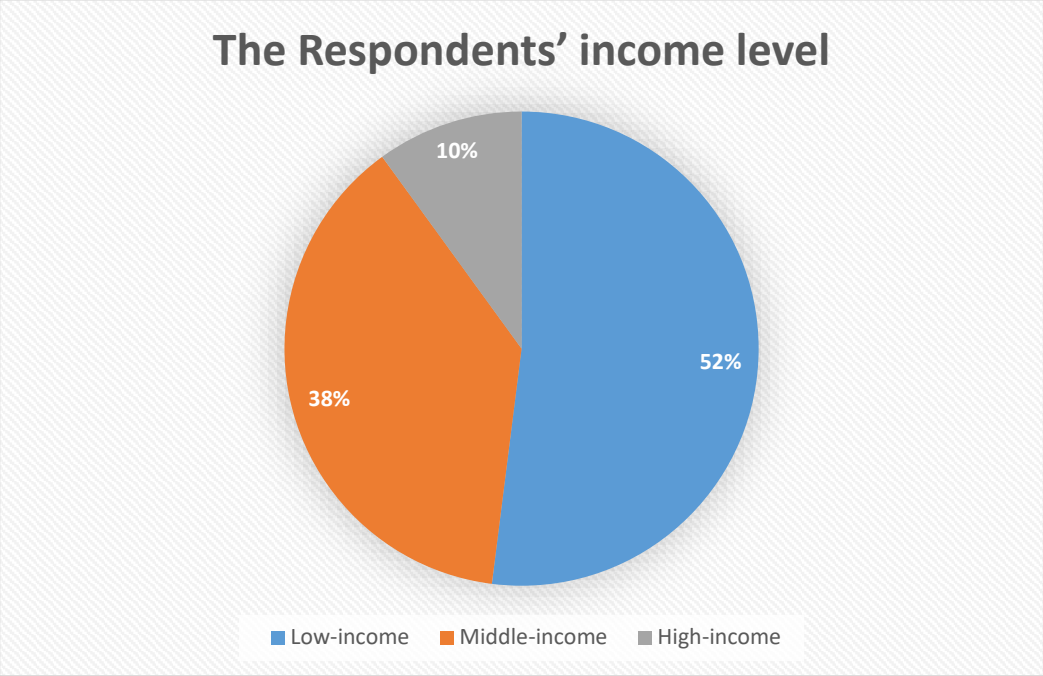
Source: Treasury Department, Ministry of Finance (2010).

Table 2: The Respondents' income level

Income level	Number of the respondents	Percentage
Low-income	26	52%

Middle-income	19	38%
High-income	5	10%

Figure 2: The Respondents' income level



The respondents who fell under the upper-income group, which formed 10% of the total respondents, work for i.e. the government, the municipality or were head of a company. The 38% of the respondents who fell under the middle-income group worked for companies as engineers, supervisors, bankers, etc. The 52% of low-income participants were public workers.

4.2.3 House prices

Out of 50 respondents, 46 respondents (92%) said that high prices are one of the risks affecting the residents as far as shortage of houses in Nairobi County is concerned, 4 (8%) respondents talked about low price, hence they were comfortable and felt that the houses within the Nairobi County are affordable depending on where in Nairobi you live. Those 4 respondents lived in a

middle-class area and were immigrants from Europe. The 46 respondents who described housing prices in Nairobi to be relatively high were a mixture of low, medium and upper class and were Kenyan citizens.

Table 3 illustrates the respondents' view of house prices in Nairobi County.

Table 3: House prices

House Prices	Number of respondents	Percentage
High Prices	46	92%
Low Prices	4	8%

4.2.4 Participants view on the EPS technology

The participants were asked if they would buy a house constructed with EPS panels.

Regarding the EPS technology, 34% of the total respondents would buy a house constructed with EPS panels. They do not care about the construction techniques used, as long as it reduces housing prices. 66% of respondents did not trust the technology and would not buy such a house.

Table 4 illustrates the responses provided by the participants.

Table 4: The participants view on the EPS technology

Answers	Number of respondents	Percentage
Yes	17	34%

No	33	66%

4.3 Interviews

The visited sites exposed deep insight towards the housing landscape in Kenya. Three individuals particularly contributed to the scope of this research:

1. Maurici Arunge, Construction manager, Hurlingham shopping center, 14 years in the construction industry.
2. Mohammed Yusuf Sheikh, Project manager, Hurlingham shopping center, 20 years in the construction industry.
3. Robert Sutton, Construction Director, NCA, 5 years in the construction industry

Mr. Arunge, who has been a construction manager for over 14 years and at the time of research working with prefab construction material expresses mixed reactions when working with EPS. He claims that although purchasing the EPS blocks is significantly cheaper compared to the usual building blocks, building the blocks together is strenuous for small scale projects and only recommends EPS for larger projects. He also proceeds to explain that fitting EPS blocks are cheaper and saves a client up to 30**%** of labour costs and that savings are just made on the slabs and not on the walls. Since most people are not knowledgeable about the EPS technology, clients who resort to utilizing the technology spend a lot of amounts of money and time close to what one would spend on conventional methods. Mr. Yusuf Sheikh, who has been a building project manager for 20 years now recently worked with EPS technology for the first time is resentful of the new innovation, saying, as he gazed at his balances that construction costs doubled by adopting this innovation. He expounds that workers who are familiar with the technology

were limited and ended up compensating them 50**%** more than he has been spending on workers of equivalent skill level to those he has been engaging with the conventional brick technology. He added that the solution to Nairobi's housing projects was not dependent on a single technology but on collective efforts by housing corporations and building contractors ensuring cheaper houses are made available for the low-income earners as he expressed remorse saying that most buildings in Nairobi are built for the middle class and top earners within the city and thus the exponential growth of slum areas. Mr Sutton blamed all the housing woes to inflated land costs across the city. He also mentioned that cheaper construction technology can be used to reduce the construction cost but due to high land cost, the reduction will not be that much. In conclusion, the high land cost in the country discourages the possibility to attain affordability housing for low-income earners. Technophobia (fear of unfamiliar ideas) is another factor limiting the utilization of technology. Sutton argues that this factor being a challenging factor for the private sector to applicate the EPS technology. Since the sector cannot reduce the construction cost by using the conventional method, they have to target clients with higher income-level. These housings are beyond low- and middle-income earners.

All three of them, however, had conditions that had to be upheld to ensure the newer technologies remained a favourite when approaching construction. Mr Sutton and Mr Arunge explained that providing knowledge about the EPS technology to the people, encouraging the developers to applicate innovative methods to constantly improve the construction process and to select low-land cost to build housing, are the three major factors to address in order to obtain affordable housing. Mr. Sutton adds that the private sector should provide the people whole range of different housing that can be suitable for the different income class. He means that the private sector should not only focus on making a good financial profit but should also provide the people low cost

housing even though the profit is not the same. Mr. Yusuf Sheikh was definitely against the EPS technology and believes that conventional method could provide an easy-going project.

4.4 Observation from Hurlingham Shopping Centre

The Hurlingham Shopping Center is located in the heart of Nairobi. The neighbourhood is a suburb mostly occupied by the upper middle class and high-income earners. It also boasts as a trading confluence where many of Nairobi residents come to shop. I was able to spend a lot of time during the construction of a new shopping mall, which is just adjacent to another popular mall called Yaya centre.

The project is estimated to measure up to 8092 sqm and designed to utilize EPS Technology. The new shopping centre will be branded as 'The Hurlingham Shopping centre' upon its expected completion in 8 months' time. Although an EPS project of this stature should be taking four months to be done, the unfamiliarity with the relatively new technology with the contractors doubled the construction period. Many stores are housed by the two-storey building with 47 at the ground floor and 37 on the first floor which measures 20 sqm apart from two of them which are slightly bigger.

The estimated cost of the project was initially KeSh 30,000,000 (USD 300,000) but the expenses ended up doubling as the engineers were sceptical of the walls being able to support themselves. Their claims, however, seemed valid as many of the construction workers had barely had their hands on the technology hence differing opinions on reliability, self-sufficiency, and workability. The owner and the construction professionals were however unanimously undeterred by the rise in costs. Stores on the ground floor will

sell at KeSh 2,000,000 (USD 20,000) while those on the first floor will cost KeSh 1,500,000 (USD 15,000).

Sitting on 8092 sqm of land leased at USD 3000 per month, the shopping mall has a parking lot that can accommodate up to 100 cars. Also, worthy to note is the increase in leasing cost by 10% every two years.

Limited experience in EPS technology was the major impediment during the construction of Hurlingham shopping mall which led to the incurrence of more costs and time as well.

Picture 1: Hurlingham Shop center 3D view

4.4.1 Materials

The project utilizes EPS panels, which consist of wall and slab panels. Concrete was used to reinforce the panels and steel to stabilize the building. Additional materials used in this project are the different types of mesh (U-, angle-, and flat), cement, steel, sand and ballast. 67% of the total construction cost was building materials costs.

Picture 2: Hurlingham Shopping center construction site

4.4.2 Labour

Labour cost is relatively cheap across the continent. Since this project was utilizing Prefabrication technique (EPS) fewer labourers were needed to run the project. Both skilled and non-skilled workers are needed for the construction process to run smoothly. The skilled personnel normally partake supervisory and technical roles while the non-skilled workers take on the manual tasks. The skilled individuals usually have the technical expertise and hence earn more than double compared to what their unskilled workers earn (USD 2 compared to USD 5 per day). The unskilled workers are commonly known as ‘’Helpers’’.

There were only a few skilled labours who worked with the EPS technology before and they made sure to use that to their advantage in order to increase their income from the project. They extend a work that could have been carried out in one day to up to three days in certain cases. Since the construction manager and the site engineer did not have the same knowledge about the EPS technology as the skilled work, they could not determine whether they told the truth or just an excuse to extend their working hours.

This problem was repeated many times to the level that all labours were kicked in the middle of the project and a new contractor was hired. The labour cost was 25% of the total construction cost.

Labour Title	Cost [Kesh] per day
Skilled labour	1200
Unskilled Labour	500

Table 7: Labour cost

Picture 3: The shilled labour in green vest guiding the "helpers" how to install the slab panels correctly

4.5 Observation from an EPS house in Kisumu

To investigate the EPS technology's theoretical advantages (since the land cost within the Nairobi county is through the roof), An observation on a house build with EPS panels located outside Nairobi county was necessary. The

observation took place in an area called Milimani in Kisumu. Kisumu is the third biggest city in Kenya.

The picture below shows a 120 sqm four-bedroom house located in Millimani. The total construction cost of this house was Kesh 5.5 million (around $54 000) and each room is 20 sqm. They used EPS Panels to build the house. The building materials cost 60% of the total construction cost.

Picture 2: four-bedroom house in Millimani

The house was built by three skilled labours and four unskilled labours and was erected in a month. Labour cost for this project formed 35% of the total construction cost. Unlike the Hurlingham shopping Center, this project was finished within the time frame and didn't exceed the budget.

The information about the land cost of this project was not provided except that it is purchased.

4.6 Summary of results

The report sought to identify a possible solution to the shortage of affordable housing in Nairobi County. The results were made on how the respondents of Nairobi County expressed their concerns about the issue. Based on the response rate, it was found that 83,3 % of the respondents participated in the research and responded positively to the questionnaire, 16,7% never returned the questionnaire.

A large part of the participants were families who gave completely different answers than single participants. Although most of the respondents with family fall into the middle-class category, they are still struggling to afford housing prices in Nairobi County. This is because of the size of the household as it plays an important role in the affordability of housing. The respondents who had positive attitudes towards housing prices in Nairobi County were mainly Europeans who lived in Nairobi for quite a while and lived in a middle-class area with a good income level. Most respondents did not rely on EPS technology and preferred the traditional method. The smaller proportion of respondents didn't care about which technology is being utilized as long as the housing prices within the county are being reduced.

The interview with the various individuals in the construction industry gave mixed feelings about eps technology. They all agreed that the limitation of the technology must be resolved in order to utilize the technology for its theoretical advantages.

The observation was to determine if the EPS technology could reduce the total construction cost in order to mass produce affordable houses. The observation of Hurlingham project gave the result that the EPS technology didn't provide the theoretical advantages that were expected. Instead, the total construction

cost and construction time was doubled. This is due to the contractor who took advantage of the lack of knowledge about the construction technique among the engineers involved in the project. From labour cost point of view, the project (Hurlingham Shopping center) has saved money with the EPS technology, but this doesn't mean that it reduced the overall construction cost. Lack of knowledge about the technology has affected the project frightfully to a point where they have decided to not build the third floor. As shown in Figure 3, building materials takes up to 67% of the total cost. Labour cost 28% and other cost estimated around 5%.

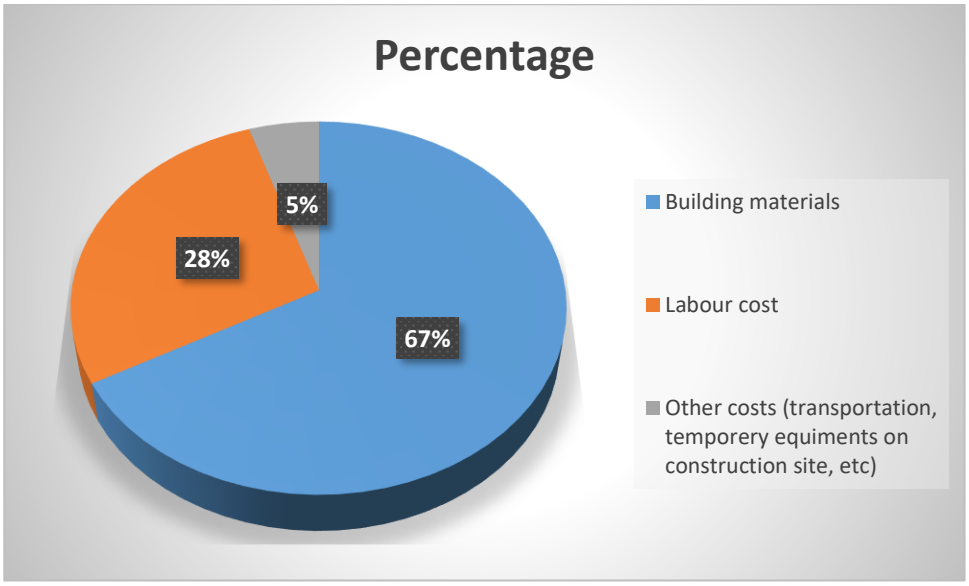


Figure 3: Hurlingham Shopping Center project cost

The observation in Kisumu illustrates that the EPS technology could be utilized to obtain cheaper houses that could solve the housing menace in Nairobi. A four-bedroom apartment in Nairobi (in a middle-class area) costs between Kesh 15 000 000 – 20 000 000 (USD 150 000 – 200 000). The land cost was not a major problem for both projects. The Hurlingham shopping centre didn't purchase the land and the land cost of the EPS house in Kisumu was not provided except that it was purchased and not leased. The land in Kisumu was concluded cheap as the construction cost was very low.

5 Discussions

The questionnaire provided the different views on the housing issue from residents of Nairobi County. As a large proportion of the participants were low-income and middle-income earners, their answers were very helpful in drawing a conclusion on the subject. As stated in the literature review, the housing shortage mainly affects the low- and middle-income earners, therefore the responses from the participants were of great benefit to the work. Even though the EPS technology could provide cheaper housing prices, most of the respondents did not trust the technology and preferred the conventional method. This prevents private developers from utilizing EPS technology to reduce construction costs and provide better housing prices for the citizen of Nairobi county. Since many people do not trust the construction technology, the private developer cannot use the EPS technology other than the conventional construction method in order to obtain financial profit. This can be linked to Forbes & Ahmed (2004) discussion about the limitation of implicating innovative technologies in developing countries which are fear and doubt.

The findings of the report show that the construction cost and the inflated land cost were one of the key problems leading to the shortage of affordability to the housing from an engineering point of view. House prices were considered as the major problem to the residents of the Nairobi county as most people were within the low-class index. To reduce the land cost, Hassanali (2009) statement about housing projects should be considered. Hassanali explains that housing projects for low-income citizens should be placed in places of low-land cost to reduce the land cost component of each residential constituent which will enable the sale at lower- prices.

The observation on Hurlingham's shopping center enabled to get the most information needed for the utilization of the EPS technology and its limitations. The second observation in Kisumu provided the information needed to draw a conclusion on the limitation of the construction technology. What prevented the Hurlingham project from achieving the benefits of the construction technology (EPS) was the lack of knowledge of the EPS technology among the engineers on the construction site. The skilled labours were few, and they were the ones who knew how to build with the EPS panels which they used for their advantage of this by extending the construction time. Since they get paid daily, more time gives them more money. It is safe to say that the skilled labours were the men in charge of the project since the construction engineer and the site engineer didn't have the same knowledge about the construction technology. The outcome of this is not a surprise at all. Applicating lean construction could provide more efficient workflow. Lean construction method would be very limited in this context since the concept of the method focuses on providing the client the maximum possible value, in other words, the satisfaction of the clients. Due to low wages in the country, everyone in the construction process aims to maximize their income which will create a lot of wastes. These wastes will affect the construction budget and the construction time which has been seen in Hurlingham Shopping Centre.

The observation in Kisumu illustrated that the EPS technology could be a solution to the shortage of affordable houses in Kenya. It also highlighted that houses should be built in places of low-land cost to mass-produce affordable houses for the low-income earners. Because of the price difference between the EPS house in Kisumu and the 4-room apartment in Nairobi County, it was concluded that the land cost limits the EPS technology ability to reduce housing costs.

6 Conclusion

Theoretical point of view, The EPS technology could be a solution for the housing shortage of affordable housing in Nairobi county but when it comes to actuality, there are many other factors that influence the technology. The solution to the housing problem in Nairobi county cannot be solved only by introducing cheaper construction technology alone. Even if cheaper construction technology could be used, the housing prices wouldn't be much cheaper. As mentioned, the land cost will always affect the industry to obtain affordable housing. The technology cannot be widely adopted in Nairobi due to factors such as technophobia (fear of unfamiliar ideas) and limited dealers with such technology. To make the people understand that the construction technology doesn't differ from the conventional method and that it provides affordable housing, is an essential step towards obtaining affordable housing in Nairobi county utilising the EPS technology. Combining EPS technology with Lean construction method, could be a solution to mass produce affordable housing in Nairobi county.

7 Recommendation

Due to the high rate of urbanisation and the economic growth in Nairobi, the development of the construction industry will increase. A further study about the combination of Lean construction and EPS technology in Nairobi could provide a new way of thinking in the construction industry in Nairobi.

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9 Attachments

9.1 Questionnaire

1. How old are you?
2. What's your ethnicity?
3. Which area in Nairobi do you live in?
4. Which income category would you describe your income level? choose the income group that describes your income level using the Treasury department, the ministry of finance category from 2010.

Earning sector	New Classification (Kshs)	Old Classification (Kshs)
Lower income group	0-23,671	0-10,000
Middle income group	23,672-111,999	10,001-40,000
Upper income group	More than 120,000	More than 40,000

Source: Treasury Department, Ministry of Finance (2010).

5. What is your work status??
6. Would you buy a house build with EPS panels? (The EPS panel is a construction technique where the panels are prefabricated in a factory and the panels are assembled onsite. The technology is known to minimize the total construction cost and construction time)
7. What is the size of your household?

9.2 Interview

Construction manager

- What is your title?
- What is your educational status?
- How long have you been involved in the construction industry?
- How long have you worked with the EPS technology?
- What are the advantages of the construction technology?
- What are the limitations of the EPS technology?
- Do you think the advantages of the technology depends on the project size?

Project Manager

- What is your title?
- What is your educational background?
- How long have you been involved in the construction industry?
- What are the advantages of EPS technology?
- What are the limitations of the EPS technology?
- Do you prefer the conventional method over EPS technology?

Construction director

- What is your title?
- What is your educational background?
- How long have you been involved in the construction industry?
- Could the adoption of innovative construction technology, such as EPS technology, solve the housing shortage in Nairobi?
- What are the limitations of innovative construction technology in Nairobi?